CHAPTER 7

INLAND PETROLEUM DISTRIBUTION SYSTEM

Section I. System Components

DESCRIPTION

The IPDS is a lightweight, rapidly deployable pipeline and terminal system used in undeveloped theaters. It can interface with an existing fuel source, such as a refinery, or with the Navy's OPDS. Engineers install the aluminum pipeline and pump stations. An engineer pipeline construction support company can install 3 to 5 miles of aluminum pipe in 24 hours. Quartermaster pipeline and terminal operating units operate and maintain the pipeline and pump stations once they are installed. The IPDS can start at the beach interface unit and run as far inland as practical. It can also start at a TPT or commercial facility. The TPT is discussed in detail in Chapter 6. The aluminum pipe is packaged in ISO shipping containers in 5-mile sets. It takes 13 ISO containers to transport 5 miles of pipe with all the related valves and fittings. Pump station intervals depend on system hydraulics. The normal interval on level ground is 15 miles. Pipeline hydraulics are briefly discussed in Appendix C. Detailed information is provided in FM 5-482. The system is modular in design and can be tailored for any locality of operation. Basic components are pipeline, pump stations, and special assemblies.

THE 5-MILE PIPELINE SETS

All components used on the main run of the pipeline are in 5-mile sets. Each set contains material required for a complete 5 miles. There are 1,404 sections of 19-foot long IPDS single-grooved aluminum pipe with coupling clamps and gaskets. The pipe is packed in 20-foot ISO containers with 156 sections of pipe in each of nine containers. An allotment of elbows and coupling clamps for directional changes and expansion/contraction devices, as well as gate valves, vent assemblies, pipeline anchors, culvert, overcouplings, and repair clamps are packed in four additional containers. Individual components of the 5-mile pipeline sets are discussed in the following paragraphs.

The 19-Foot Aluminum Pipe Sections

There are 1,404 sections of 19-foot lengths packaged in nine 20-foot ISO containers. Each container has 156 sections as shown in Figure 7-1, page 7-2. These pipe sections are used in the main run of the pipeline. They cannot be cut to different lengths due to the varying wall thickness, but each end may be regrooved once if damaged.

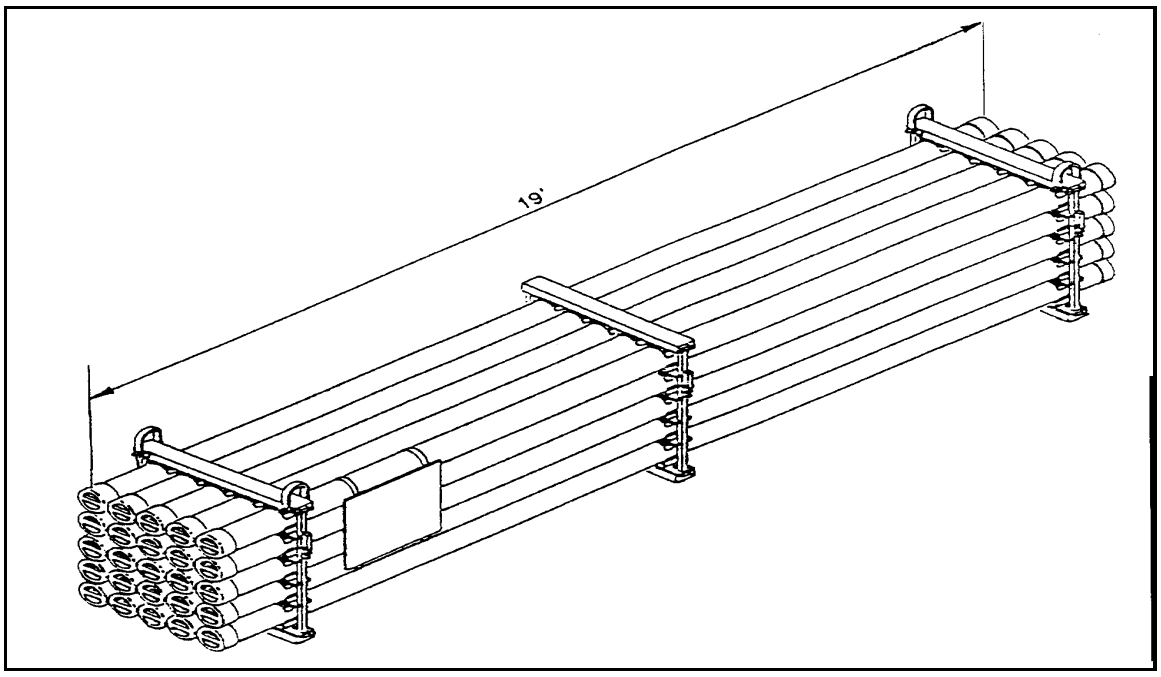

Figure 7-1. 19-foot aluminum pipe sections

The 9.5-Foot Aluminum Pipe Nipples

There are also forty-four 9.5-foot long pipe sections (Figure 7-2), or nipples, in each 5-mile set and 10 sections with each pump station. These pipe sections are used anywhere in the pipeline where odd length sections are needed. They have a constant wall thickness and can be cut to any length and regrooved using the cutting, grooving, and beveling machine. Each 9.5-foot section has a black line down the length for easy identification of nipple material.

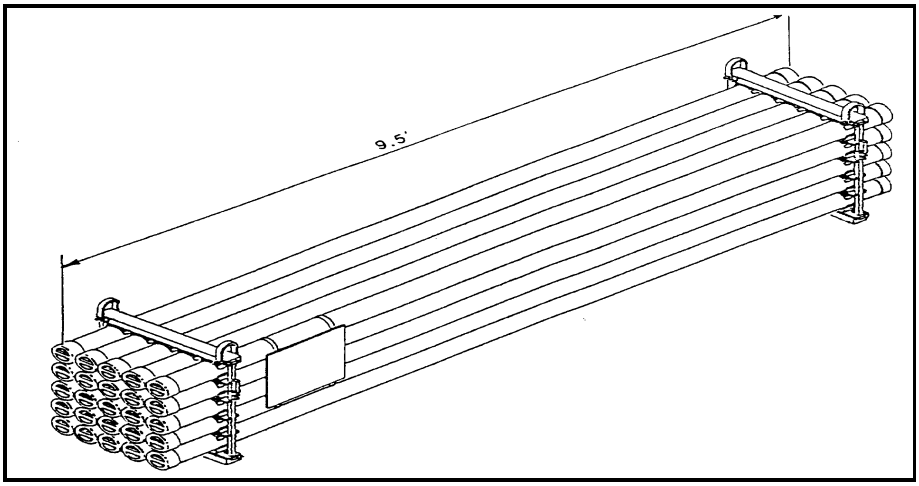

Figure 7-2. 9 .5 foot aluminum pipe nipples

IPDS Single Grooves

The special groove design is wider than the standard commercial groove used with most pipe around the world and is not interchangeable with the standard groove. The IPDS single grooves are found on the high pressure pipeline and pump stations. The maximum allowable operating pressure is 740 PSI.

High-pressure Coupling Clamps

The clamp has an integral gasket that makes pipe connections relatively easy. The coupling clamps come in sets of 25 clamps to a box. Packed in the box with the 25 clamps are a hammer, extra gasket, extra retaining pin, a drift pin, and two assembly tools. The gaskets require lubrication for assembly.

Gate Valve Assembly

Gate valve assemblies are used as isolation block valves in the pipeline at about 1-mile intervals. The gate valves are skid mounted, 6-inch ANSI class 300, steel valves, with IPDS single groove ends. Gate valves are operated either fully open or fully closed. There are five gate valves with each 5-mile set.

Check Valve Assembly

Check valve assemblies are used near the bottom of major grade changes in the pipeline to prevent backflow of fuel. They are skid-mounted, 6-inch ANSI class 300, steel valves. A hinged disk allows fuel flow in only one direction. Fuel flowing in the right direction pushes the hinged disk out of the way. Fuel flowing in the return direction pushes the disk against its seat and closes the opening. An arrow on the valve indicates the direction the fuel must flow to open the valve. Check valves are self-operating and require little maintenance. There are three check valves in each 5-mile set.

Pipeline Vent Assembly

The pipeline vent assemblies are made of a 1-foot long section of 6-inch steel pipe, grooved on both ends to receive the IPDS single-groove coupling clamp (Figure 7-3). The short section has a weldolet coupling and a 3/4-inch ball valve, fittings, and nipples. The vent assemblies are installed, as determined by pipeline designers, at high points to vent air from the system. By changing their position, they can be used as drains at low points if necessary. There are five of these in each 5-mile set.

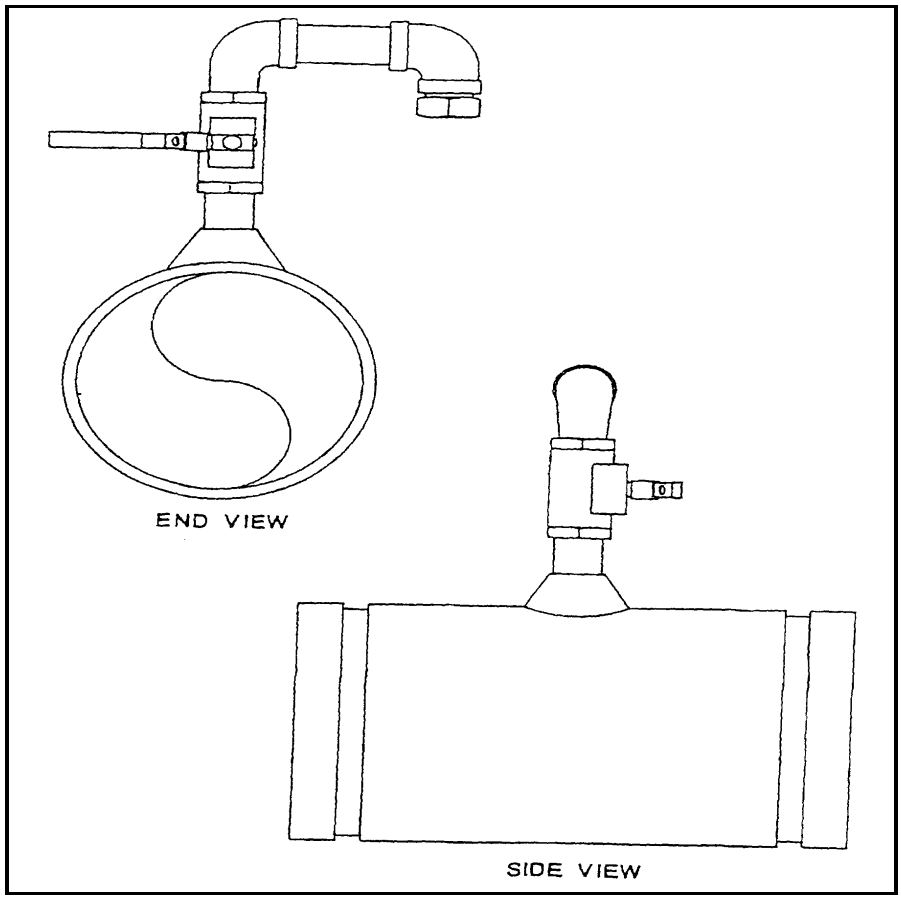

Figure 7-3. Pipeline vent assembly

Pipeline Drain Assembly

Three pipeline drain assemblies with 2-inch ball valves and plugs are in each set. They are similar to the vent assemblies, however, they are designed to be placed in low areas of the pipeline to aid in fuel recovery when the line must be drained.

Elbows and Tees

The IPDS comes with elbows and tees for directional changes in the pipeline (Figure 7-4). Each 5-mile set has elbows to allow turns and expansion/contraction. There are sixty-two 90-degree, fifty-nine 45-degree, ten 22.5-degree, ten 11 1/4-degree, and twelve 6-degree elbows to give flexibility in laying the pipe. There are two sizes of 90-degree elbows in the system. The long elbow is in the elbow set and is used in the pipeline. The short elbow is only found in pump stations and must not be used on the pipeline.

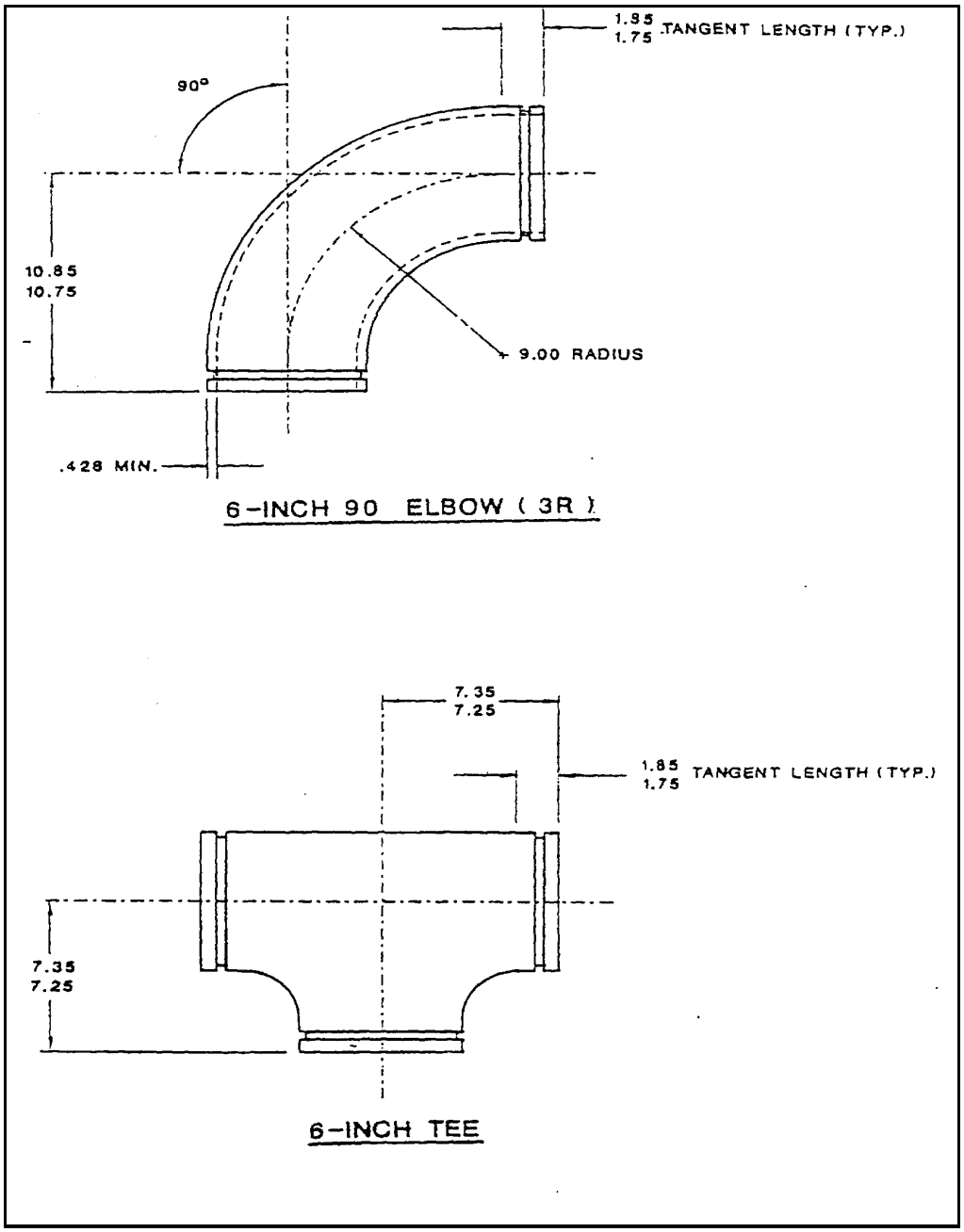

Figure 7-4. Elbows and tees

Pipeline Anchors

Pipeline movement caused by thermal expansion will usually be in the direction that provides the least resistance. Anchors (Figure 7-5) are used to direct movement toward expansion devices. Anchors should be located at midpoints between expansion devices. There are 48 anchors with clamps in each 5-mile pipeline set.

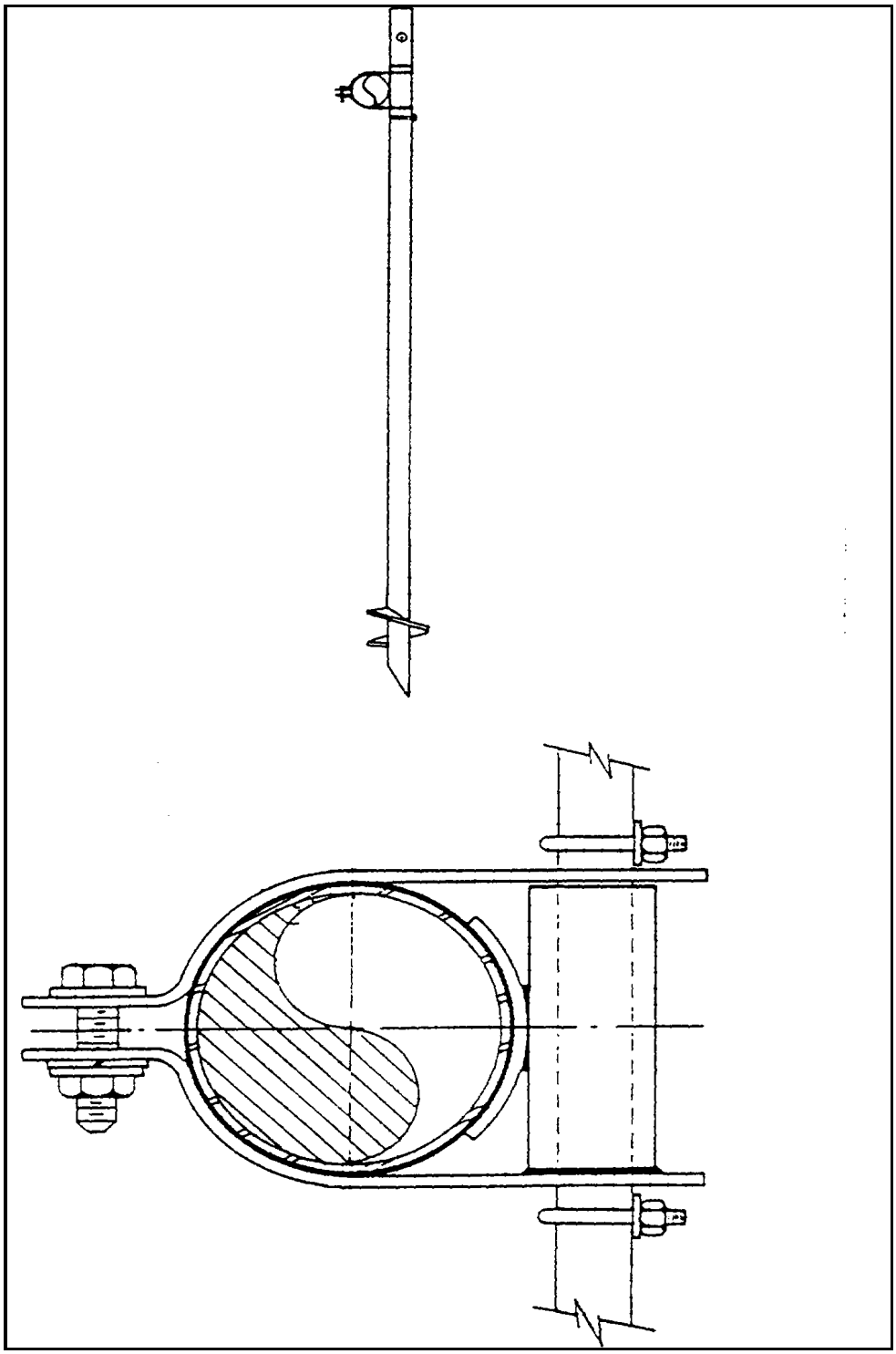

Figure 7-5. Pipeline anchors

Elevated Critical Gap Crossings

Elevated critical gap crossing materials are designed to allow the IPDS pipeline to cross up to 250-feet of water or a gully. An adequate pipeline expansion system must be provided to compensate for longitudinal thermal expansion of the pipeline on the crossing. Pipeline anchors are required to isolate the critical gap crossing expansion system from the main pipeline. There is a 2-foot minimum clearance above the high water level to permit floating debris to pass under the pipeline. Existing bridges may be used for gap crossings. If the bridge attached system is not practical in the field, the line is routed over the bridge deck using tunnel passage sets. The crossing material is part of the pipeline support assembly.

Nestable Steel Culvert

Nestable steel culverts are used when existing culverts are not available and bridges cannot be used for roadway crossings. These culverts are easily constructed by two people using only a stitch assembly and bending bar. There are 80 linear feet of nestable culvert with each 5-mile pipeline set for constructing road crossings.

Cutting, Grooving, and Beveling Machine

The portable pipe cutting, grooving, and beveling machine is used for the end preparation of IPDS pipe and piping components (Figure 7-6). The machine can bevel IPDS aluminum pipe in preparation for butt welding. It can also groove the pipe to accept the coupling clamp and gasket. The machine consists of a split frame with an external chucking system that simultaneously centers and squares the machine on the pipe. It can be powered by pneumatic, electric, and hydraulic drive motors.

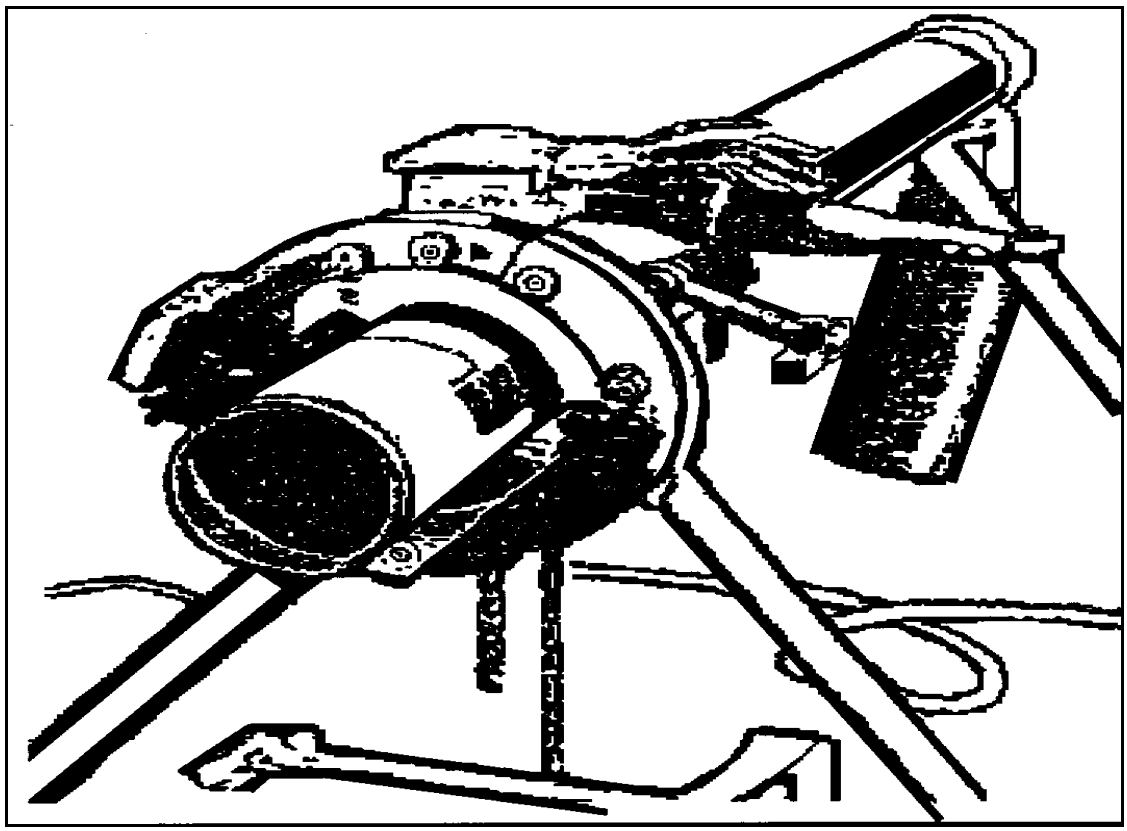

Figure 7-6. Cutting, grooving and beveling machine

Hydraulic Drive Head and Anchor

The hydraulic drive head used for installing pipeline anchors consists of a hydraulic drive head, which can be mounted on a JV-410 backhoe or the small emplacement excavator digger stick after removing the bucket, and anchor adapter. The anchor is a 1.5-inch square forged steel shaft, 60 inches long with a 6-inch diameter tapered helix welded on the bottom. When pressure is applied and the anchor is turned clockwise, it augers itself

into the ground. A clamp is installed around the pipeline and fastened to the anchor shaft, anchoring the pipe to the ground.

Tapping Machine

The pipeline hot tapping machine is used for tapping into a pressurized pipeline to install a service tap or pressure-relief device. These devices can be installed without stopping the flow of fuel in the pipeline. The machine uses a hole saw and a holder-pilot to cut the pipe. The holder-pilot holds the cut pipe plug after cutting so it can be removed. The machine has an adjustable automatic feed rate for any cutting condition. It comes with a ratchet crank for manual operation.

PUMP STATIONS

Each pump station has two skid-mounted, diesel engine-driven, mainline pumps (800 GPM). Launcher and receiver assemblies, a dual in-line strainer assembly, and a floodlight set are also components of pump stations. Except for the mainline pumps, all pump station equipment will be stored in 20-foot ISO containers.

The 800-GPM Mainline Pump

The 800-GPM mainline pump is a horizontal split case, three-stage centrifugal, skid-mounted unit as shown in Figure 7-7. It is driven by a turbo-charged diesel engine. The pump contains a connect-disconnect clutch to allow the engine to run without turning the pump. It has an automatic pump controller with two modes of operation: manual engine speed control or discharge pressure control. The manual engine speed control sets the engine speed (RPM) regardless of the discharge pressure. The discharge pressure control regulates the engine speed to correspond to the discharge pressure set by the operator. Conditions such as high coolant temperature, low oil pressure, low pump suction pressure, or engine overspeed will allow safety shutdown devices to override either control mode. The instrument panel has a tachometer, voltmeter, lube oil pressure gage, a coolant temperature gage, and suction and discharge pressure gages. The pump has a discharge head of 1,800 feet and is rated at 3,450 RPM. The engine is a 855-cubic-inch, six-cylinder rated at 450 horsepower at 2,100 RPM. The entire assembly is 281 inches long, 79.5 inches wide, 132 inches high. It weighs about 14,230 pounds.

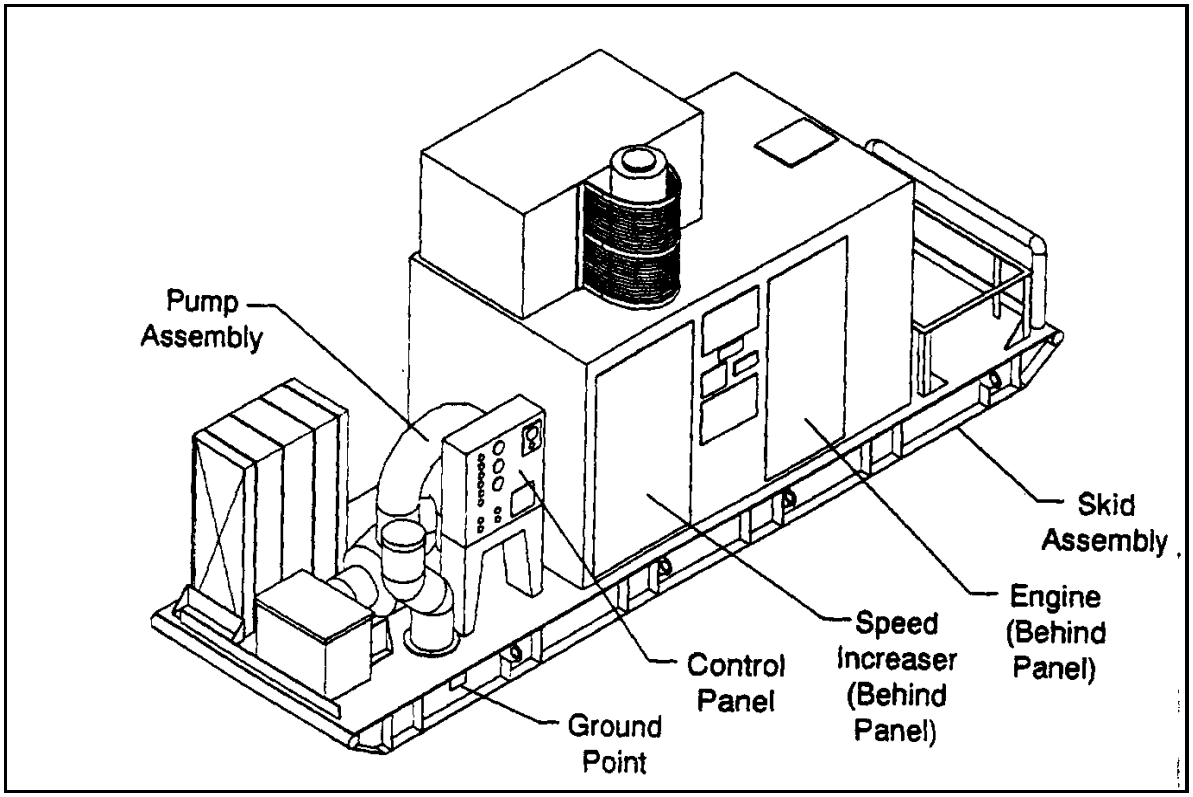

Figure 7-7. 800-GPM mainline pump

Scraper Launcher Assembly

The launcher assembly used to launch the pipeline scraper consists of the steel skid, the launching barrel, and related piping and valves (Figure 7-8). All components of the launcher assembly are steel. The launching barrel has a quick-opening closure, a pressure gage, a drain valve, and vent valve. Located on the bypass is a ball valve under a 1-inch thermal relief valve. The initial set relief pressure is 740 PSI. The set pressure can be adjusted as necessary, depending on the location of the system. The relief valve discharge is tied into the discharge line from the vent valve on the launching barrel. A 2-inch diameter, 25-foot long hoseline is connected to the vent and drain to dispose of fuel when the barrel is being emptied. A scraper passage signal is provided on the downstream part of the assembly. The scraper launcher assemblies are supplied with the pump stations and are on the outlet side of the pump stations.

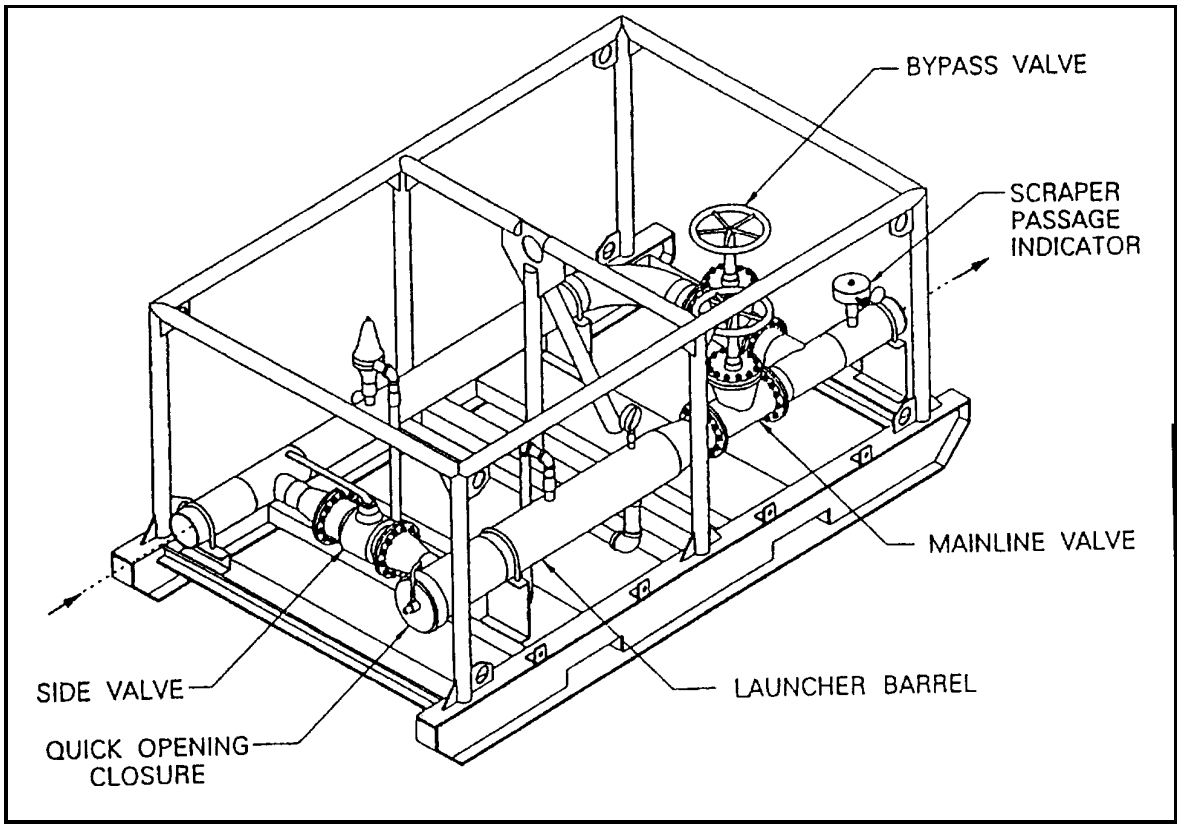

Figure 7-8. Scraper launcher assembly

Scraper Receiver Assembly

The skid-mounted scraper receiver assembly consists of the receiver barrel and the related piping and valves as shown in Figure 7-9. All components of the receiver assembly are steel. The receiver assembly has a quick-opening closure, a pressure gage, a drain valve, and a vent valve. The set pressure is 990 PSI. The set pressure is to be adjusted, as necessary, depending on the location in the system. A scraper signal is located at the entrance of the receiving barrel.

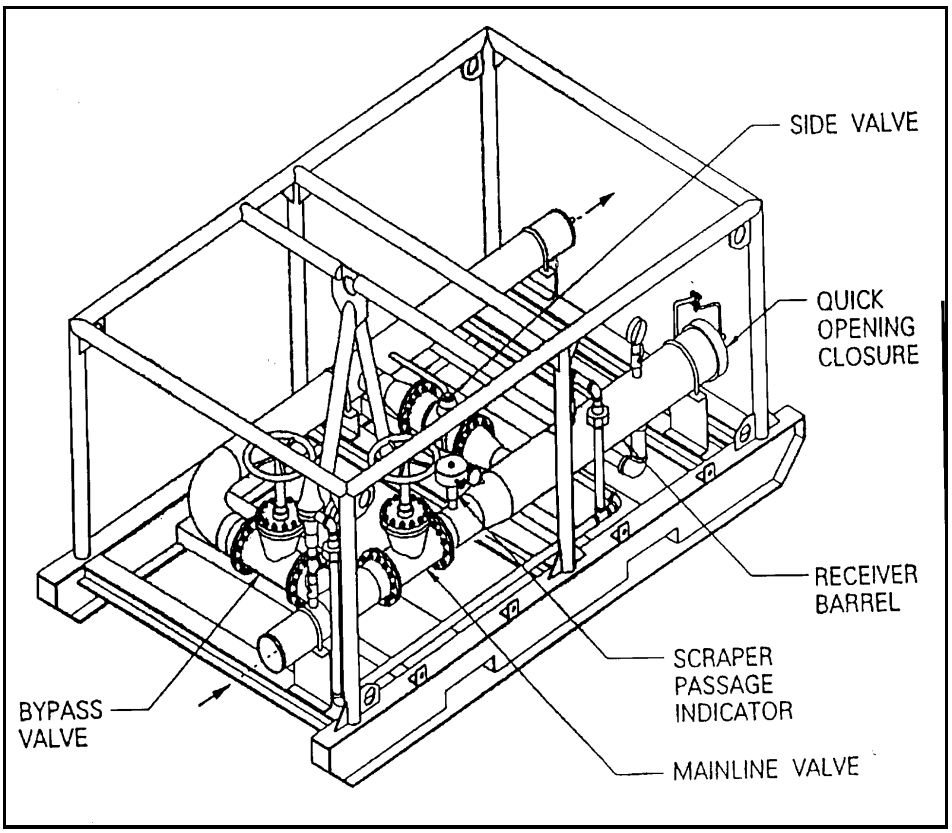

Figure 7-9. Scraper receiver assembly

Strainer Assembly

A strainer assembly is installed in pump stations, upstream of the pumps to protect them from damage due to dirt or debris in the pipeline. The skid-mounted steel strainer assembly has two separate in-line vertical strainers as shown in Figure 7-10, page 7-10. The strainers have quick-opening closures to allow easy access to the strainer basket. Each strainer has a differential pressure gage and two ball valves. There is a 1-inch ball valve for draining the strainer from underneath and a 1/2-inch ball valve for pressure venting. The assembly has four 6-inch gate valves so either strainer can be bypassed for cleaning without interrupting fuel flow. A 1-inch drain hose is supplied with the strainer assembly.

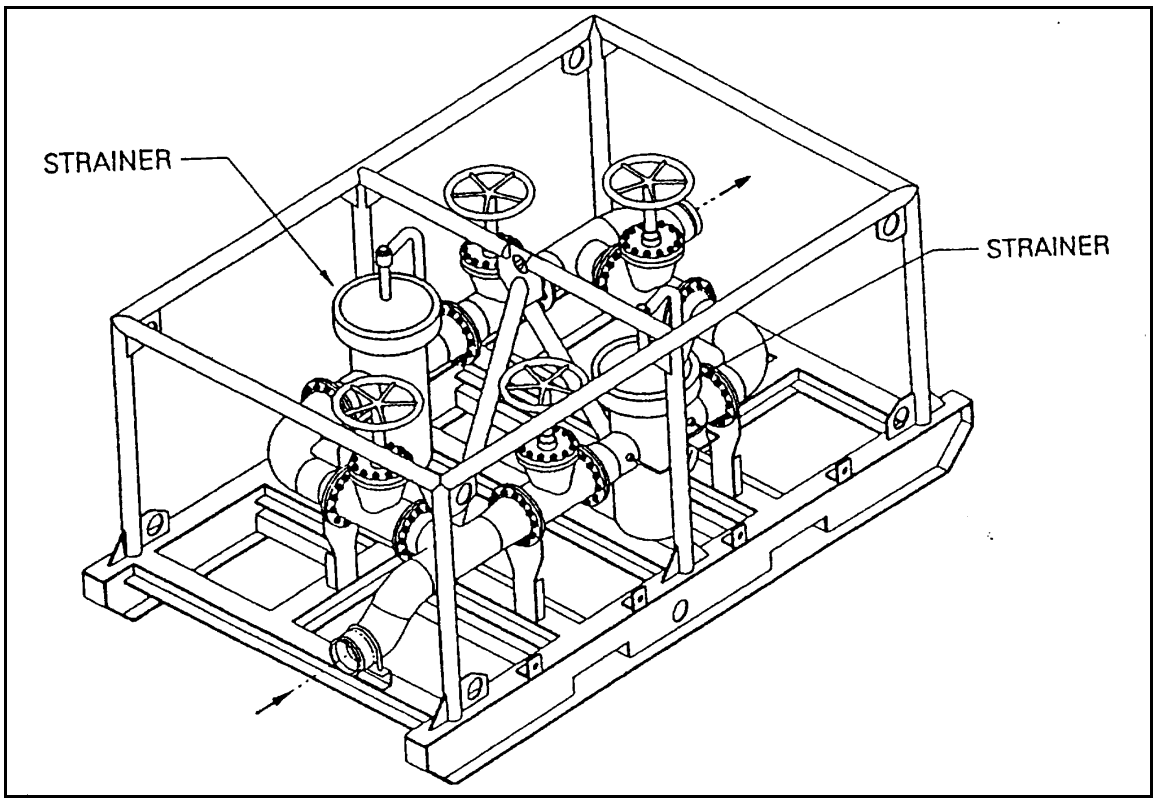

Figure 7-10. Strainer assembly

Floodlight Set

Floodlight sets are components of the pump stations. Floodlight sets are discussed in Chapter 6.

The 3,000-Gallon Collapsible Fabric Tank

A 3,000-gallon collapsible fabric tank is installed at each pump station to supply the station with fuel. The tanks can be filled by connecting to the pipeline or or by tanker-truck. The same hose is used to receive fuel into the tank and dispense fuel to the 110-gallon tank on the pumps. For detailed information on the 3,000-gallon collapsible fabric tank, refer to Chapter 22.

TACTICAL PETROLEUM TERMINAL

The standard TPT has storage capacity of 3,700,000 gallons in eighteen 5,000 barrel (210,000-gallon), collapsible fabric tanks. The TPT is modular with three identical fuel units. Each TPT also has one pipeline connection assembly. The total TPT is stored in 77 ISO containers. For detailed information on the TPT, refer to Chapter 6.

Section II. INSTALLATION

PLANNING

Good predeployment and on-site planning are very important for a successful pipeline and pump station installation operation. This planning includes environmental protection regulations at all levels, including federal, state, local, and host-nation. The role of host nation support, fuel type and quantity to be supplied, location of existing facilities, terrain to be crossed, and distances from bulk facilities to using units or terminals are all planning factors for the IPDS.

Route Reconnaissance

When conducting a site and route reconnaissance, you must have two known points:

- Where the fuel source is or will be located.
- Where the forces will be located requiring support.

When you are conducting the physical reconnaissance, on foot or by vehicle, stakes or other marking devices must be used to show the actual path of the pipeline. Location of valves, anchors, expansion/contraction devices, and any obstacles must be marked on the trace. Pump station locations can be adjusted somewhat from the locations selected from the profile and hydraulic analysis. However, every effort should be made to locate pump stations near their ideal location.

Pipeline Route Selection

Selecting the best route for the IPDS pipeline is crucial to proper operation and continuous flow of fuel to users on the battlefield. As mentioned above, a thorough initial reconnaissance is required to select the best pipeline route. Even with a thorough reconnaissance, changes may have to be made to the selected pipeline route because of unforeseen problems. Changes can be made as long as they do not cause a functional fault in the system. The staked-out routes and sites should be clearly recorded on current area maps. The route stakings should be line-of-site and readily visible to the route preparation and pipeline-laying crews. Note the type of soils and terrain so that earth-moving and other route preparation and other route and site preparation activities can be planned. Select routes that require little grading. If grading is required, gradable soils are preferred over rocky terrain. Avoid steep lateral or axial grades if possible. The fewer special support and guide devices required due to terrain the better. Select a pipeline route that is accessible from existing roadways whenever possible. This will aid in installation, inspection, operation, and maintenance. However, do not lay the pipeline so that it may be damaged by passing vehicles. The initial reconnaissance must also determine the methods of handling various pipeline crossing situations. Crossings are grouped into three main categories:

- Elevated critical gap crossings
- Existing bridge crossings
- Road crossings

A route requiring fewer newly constructed gap and stream crossings is better if the hydraulic design of the pipeline is not adversely affected beyond the designed pipeline pumping capabilities. If crossings have to be made, record the type of crossing device and the length of the crossing so materials and equipment can be supplied in the correct quantities at the proper location. Stake out the crossing location and record special grading, ditching, or other earth-moving requirements. Schedule the delivery of materials and work on these crossings before the pipeline-laying crews arrive. When planning pipeline routes, avoid congested or populated areas. Consider camouflage and security against tampering and sabotage.

Pump Station Site Selection

The sites selected for the pipeline pump stations must be compatible with the hydraulic design of the pipeline and vice versa. As a general rule, pump station siting takes precedence over the pipeline routing. However, the actual site chosen often represents a compromise between the ideal station location and the pipeline routing. If compromises must be made, always make them on the safe side of the hydraulic design, even if it means a more difficult installation process. In the initial reconnaissance, consider the adequacy of the preselected sites for pump stations. If relocation is required for some reason, note the change on the records and stake the sites. It is assumed that coordination with the host nation refinery or bulk facility has been made if needed. The initial reconnaissance should determine the booster pump station locations and a stakeout of it. Determine the point of tie-in for the hoseline to the booster pump from the TPT or host nation bulk facility. Determine the fittings, pipe, and hoseline required to be taken from pipeline and TPT stock. If a host nation facility is used, they must provide the tie-in pipe nozzle and valve at a location acceptable to the facility and the pipeline. Pump station

sites must be easily accessible. A roadway is the best access; however, a heavy-lift helicopter can be used if a roadway is not available. Set up the pump station if possible on firm soil to support the weight of the equipment. A special foundation, such as compacted backfill, may be needed if the soil is marshy or soft. Make sure that the area does not flood. Any water accumulation in the area must be able to be pumped out. The area must be about 330 square meters (3,552 square feet), about 28 meters (91.9 feet) by 12 meters (39.4 feet). A space of about 8 (26.25 feet) by 8 meters (26.25 feet) is required for collapsible fuel tanks used to fuel the pump engines. This area must be within 60 meters (196.8 feet) of the pump engines but at least 30 meters (100 feet) away from the operating area. Do not set up the collapsible fuel tanks in an area higher than the pump station operating area. These provisions could include drainage ditches or swales.

SITE AND ROUTE PREPARATION

Prior to installation of the IPDS, the site and route must be prepared. The following paragraphs briefly describe these preparations.

Pump Station Access

Pump station sites should be accessible by road for construction, operations, and maintenance. The road should be wide enough to permit two-way traffic and turnaround. If the roadway cannot enter the site because of terrain, decide on another method to move construction and system operating equipment from the nearest roadway. Skid and hoist equipment, tracked vehicles, or heavy-lift helicopters may be used.

Pipeline Access

There must be access to the pipeline, whether there are existing roadways or new ones have to be constructed. Newly constructed roadways should be parallel to the pipeline route. These roadways may be graded at the same time as the pipeline trace. The main use for these roadways is for construction, inspection, and maintenance; not routine use. The roads should be at least 10 feet wide, well graded, and well drained. Unless the ground is very soft and marshy, there is no need for gravel surfacing. If a road construction problem arises, the roadway does not have to be set up right next to the pipeline. Because the pipeline sections are light, they can be carried short distances by two men to the pipeline construction site.

Site Preparation

Depending on accessibility, it may be necessary to prepare the route before the pump station site. The pump station sites must be prepared in such a way as to accommodate an acceptable plot plan, access roads, and laydown areas. When preparing sites, remove heavily organic or marshy soils at the planning site and replace them with compacted nonorganic soils. Slope all sites so that any spills are drained away from the area. Use swales and ditches to help drainage. Some areas may require digging and lining a sump to catch any fuel spills. When planning and preparing the pump station sites, designate an area outside of the operating area as a laydown area. This area will be for receiving, sorting out, and controlling the boxes, crates, and equipment delivered for the facility. This area should be about 3,000 square feet and have road access.

Route Preparation

The pipeline route must be prepared at the same time that the access roadways are prepared. Schedule this operation well in advance of the pipeline equipment delivery. Pipeline route preparation provides access for pipeline installation. This surface will be used to lay the pipeline and establish the support, anchoring, and expansion/contraction system. The pipeline route should be about 10 feet wide. It should have 30-foot wide areas for the expansion/contraction devices. Lay as much of the pipeline directly on the ground as possible. The ideal situation is continuous ground support; however, at a minimum, the pipeline should be supported every 19 feet. Use earth-moving equipment to remove the high spots and obstructions and fill the low spots. This will increase the rate at which the pipeline can be laid. A field decision is required to determine specific excavation needs. Consider thoroughly the approaches to crossing situations. Use existing crossing facilities (culverts and bridges) as much as possible to prevent unnecessarily tying up construction equipment. As the route is completed, place or

replace the staking required for the pipeline construction crews. Clearly record all actions you have taken to prepare the route. This will help the pipeline installation crews know of problems they may encounter. Start sandbag filling operations so they will be ready when needed for pipeline support.

EQUIPMENT AND SYSTEM INSTALLATION

Once the site and route have been prepared begin equipment and system installation. Equipment and system installation are described below.

Pump Station Installation

The pump stations may be installed at the same time or one at a time, depending on the construction schedule. Install the pump station as given below.

- Prepare the pads for the pumps, receiver assemblies, strainer assemblies, and launcher assemblies. Install pads for other equipment as required. Install pads under valves for support or proper elevation if needed. Construct the pad and berms for the 3,000-gallon fabric collapsible fuel tanks. If needed, set up the floodlight set for operation. Set the pipeline pumps on their pads; anchor and ground them. Pay particular attention to pump and engine leveling and alignment. Set the strainer assembly in position and anchor it after the piping is installed. Set the receiver, launcher, and strainer assemblies in position and anchor them after the piping is installed. Ground all equipment during installation.

- After the berms and pads are constructed, roll out the 3,000-gallon tank inside the berm. Before installation, make sure the pad is free of any sharp objects that may puncture the bag. Slight modifications may have to be made for specific situations.

- Be careful when installing the piping. Do not cause excessive strain initially or due to pressure and thermal expansion when in operation. Before anchoring the equipment to the pad, adjust the equipment to relieve any possible strain. Enough elbows are supplied with the system to use for elevations and modified layouts. To cut down on construction time, make the most use of the standard 19-foot pipe sections without having to custom fit pieces. If smaller pipe sections are needed, only the 9.5-foot sections can be cut using the cutting, grooving, and beveling machine. The best method of assembly is to pipe out from the pumps to the strainer and receiver, and then to the launcher. In the pump station, hold joint deflection to 1 degree at installation rather than the 2 degrees allowed on the pipeline. Before connecting any pipe sections together or to other equipment, make sure the joints are clean, both internally and externally.

- Place fire extinguishers in the area where they are clearly visible. Place one fire extinguisher at each pump, one at the receiver, one at the launcher, and one near the 3,000-gallon fuel tank. Also, place one additional fire extinguisher just outside the immediate operating area in a highly visible location.

- Install the appropriate safety signs at the proper locations.

- When time permits, erect the lightweight panel buildings over the pumps. Paint all metallic parts that have not been previously painted or anodized or that have deteriorated during shipment. Lubricate all rotating or sliding surfaces.

- Before starting operations, clean up the area and pressure-test all connections for leaks, expansion, and contraction. The pressure testing may be done along with the purge and fill operation covered in the next section. Make changes or repairs as necessary.

Pipeline Installation

As soon as the site preparation is done and the necessary equipment has been delivered to the construction site, the pipe-laying crews can start removing the pipe from the ISO containers and stringing it along the route. Pipe sections can be carried by two people to the installation site. Keep the protective caps on the pipe until it is ready for coupling. After stringing the pipe along the route, the pipe-laying and coupling crew follows. The pipe-laying and coupling crews install pipeline using the following procedures:

- Remove the protective cap from the pipe, align the two pipe sections by laying them in the bottom half of the coupling assembly, close the coupling assembly over the top of the pipe, and lock and pin the handle in place. (Prior to installation, place a liberal amount of grease on the inside of the coupling gasket. Make sure there is no dirt or other debris on the gasket or pipe grooves before coupling).

- Make sure there is an adequate supply of elbows on hand to allow for terrain conditions or directional changes. Install elbows during the pipe-laying process if the route or terrain requires a change of pipeline direction. If there are enough elbows available, use them for directional changes instead of cutting and grooving short pieces of pipe. This will ease the construction process.

- Position expansion/contraction devices are positioned in the pipeline based on the hydraulic design, normally every 50 couplings of 19-foot pipe. The elbows and coupling clamps included in the expansion/contraction sets must be used only with the expansion/contraction sets. Plan on having a straight pipe run of at least three or four sections going into an expansion/contraction device.

- Install isolation gate valve and check valve assemblies in the pipeline as it is laid. These locations are based on the hydraulic design of the line. Appendix C covers hydraulic pipeline design fundamentals.

- Determine the placement of the vent assemblies according to the elevation survey.

- Install the fuel sampling assemblies 1 mile upstream from each receiver.

- Install the proper pipeline support as the pipeline is laid. Drive in the pipeline anchors after correct alignment has been checked on pipeline joints and couplings to be anchored. Couple the pipeline into receivers and launchers after they have been permanently placed and anchored. Cut and groove nipples from the 9.5-foot pipe sections as needed to eliminate as much strain as possible.

- Recheck the expansion/contraction devices, alignment, anchoring, and supports after the line has expanded and contracted through at least 24 hours of temperature changes. Make corrections as necessary before initially filling the pipeline with fuel.

- Make a final inspection of the entire system before starting the pipeline into operation. See Table 7-1 for a checklist of the major points of inspection.

Table 7-1. Checklist of major points of inspection

Pipeline pumps serviced and properly installed. Anchors in place; pumps grounded and ready for operation. Check against pump manufacturer's technical manual.
Flood and transfer pumps used as booster pumps serviced and located as instructed. Check for appropriate anchoring and grounding. Ready for operation. Check against pump manufacturer's technical manual.
Dual strainer assemblies serviced, installed properly, anchored, grounded, and read to operate.
Receiver assemblies serviced, checked, installed properly, anchored, grounded, and ready to operate.
Launcher assemblies serviced, checked, and installed properly, anchored grounded, and ready to operate.
All valves operable and accessible. Packing glands tightened. Proper location in system.
Check valves installed in proper flow direction throughout. The directional arrow molded into the valve body must point in the direction of flow.
ELO pressure regulating assemblies serviced, checked, properly set, grounded, and ready to operate.
Fuel tanks, berms, and hose system properly installed.
Sampling assemblies located and installed properly, grounded, and ready to operate.
Connection into supply source handled properly.
Connection into TPT switching manifolds correct.
All couplings closed and flanges tight throughout system.
Thermal relief valves on receiver and launchers properly set and installed. Ball valves under relief valves open.
Evidence that all pressure gages have been precalibrated and are adequate. Any recalibration required will be handled as part of the commissioning program.
All valves except the gate valves installed at 1-mile intervals for isolation are closed.
All piping properly supported and guided in the pipeline.
Pipeline anchoring and expansion/contraction systems installed properly.
Gap crossing and bridge crossing systems properly in place.
All piping properly supported at pump stations.
Floodlight sets at pump stations installed and operable.
All fire-suppression equipment charged, installed in accessible and visible location, and ready for use.
Safety signs installed.
Proper equipment identification marking in place.
All drainage systems, roadways, and road crossings checked.

In addition, ensure all areas are cleaned up and unused equipment and materials are returned to a proper storage area. Do not start operations until all deficiencies found in the inspection are corrected. Ensure that procedures

are in place for disposing of all waste fuel. Make sure that operating communications systems are working properly. Conduct pressure tests at the same time as the purge and fill operations. Inspect the system during and after the test for evidence of leaks or other problems. Correct all problems or leaks after the pressure test.

Installation Equipment

Specialized equipment is assigned to the pipeline support company for handling, placing, and installing valves, pumps, and pipeline anchors. Installation equipment consists of:

- Cutting, grooving, and beveling machine,
- Hydraulic drive heads for anchor installation,
- Pipeline tapping machine,
- Deadweight tester,
- Surveying level,
- Alignment tools,
- Supplemental pipeline tool kit.

Refer to FM 5-482 for detailed information on installation equipment.

Section III. System Operation

PUMP STATION OPERATIONS

Ensure all special and local environmental protection requirements are used when the POL systems are being operated. Check with the local environmental compliance officer to identify special operating requirements. The IPDS can begin at the beach termination unit operated by the Navy. It can also begin at a TPT manifold or at a host nation bulk storage facility. Whatever the beginning point, a booster pump station feeds the 6-inch IPDS coupled aluminum pipeline. The pipeline can be used as a multiproduct pipeline for several types of fuel, including JP-4, JP-8, jet A-1, diesel, and MOGAS. In a multiproduct pipeline system, fuel batching is required. Batching is covered in more detail in Chapter 9 of this manual. In batching of fuel, different fuels have a tendency to mix where two batches touch, commonly known as the interface. The interface is diverted from the pipeline to the contaminated fuel tanks at the TPTs. This fuel may be reintroduced as a blending stock, or it may be a waste product of which must be disposed. To avoid waste, keep the interface as short as possible. As JP-8 becomes the single fuel on the battlefield, the need to batch fuels in the pipeline will stop. The continued need for MOGAS will require packaged fuel supply actions.

Pump Station Start-Up

There are a number of steps to put a pump station on-line. Pump station start-up steps are:

- Check the pump units before actual starting time. Perform before-operation maintenance.
- To start both pumps:
  - Set POWER ON/OFF switch to ON.
  - Set PANEL LIGHT ON/OFF switch to ON if needed.
  - Set MODE CONTROL MAN/AUT switch to MAN.
  - Turn ENGINE RPM/DISCHARGE PRESSURE control fully clockwise (low speed position).
  - Push ENGINE STOP switch in
  - Press PRESS TO TEST LAMPS switch. Alarm lights should come on and then go off when push button is released.
  - Verify that clutch is disengaged (down) position.
  - Press ENGINE START switch. Keep switch depressed until engine fires. If engine fails to fire, refer to the Technical Manual Troubleshooting Chart.
  - After engine starts, observe ENGINE RPM gage to verify engine is idling at its idle speed (approximately 800 to 1,000 RPM).

- Warm up pumps, with the pump discharge valves closed, until engines reach an operating temperature of 120°F at an idle speed of approximately 800 to 1,000 RPM.
- Ensure that the mainline, bypass, and side valves on the receiver and launcher are open.
- Ensure that the strainer is open and ready to operate.
- Open the suction valve on both pumps.
- When there is suction pressure, vent the air out of the pump case using the four vent valves, in order, from lowest to highest. Open valve until fuel flows from the pump, then close the valve before proceeding to the next one. Use a drip pan to catch discharged product. Dispose of all hazardous waste IAW federal, state, local, and host nation regulatory guidance.
- On the pump to be used, if there is at least 100 PSI suction pressure and increasing, engage clutch and open the discharge valve slowly. Place pump control in automatic mode and slowly increase the pump engine speed to the discharge pressure required by the dispatcher. Increase discharge pressure while maintaining 100 PSI suction pressure. If 100 PSI suction pressure cannot be kept during start-up, notify the dispatcher.
- Shut down the standby pump after the start-up discharge pressure has been attained.

Normal Shutdown

The pipeline dispatcher directs a normal shutdown. To shut down the pump, the operator slowly turns the discharge pressure control counterclockwise until the engine is idling. He switches to the manual mode and disengages the clutch. After idling for at least one minute, the operator shuts the engine down. The suction and discharge gate valves are then fully closed. Pressure should be taken off the pump by bleeding it off through the casing vents. This prevents pressure buildup due to the sun or atmospheric temperature.

Forced Shutdown

There are several reasons for a forced shutdown. The pump itself has safety shutdown features that include automatic shutdown due to:

- Low suction pressure.
- Engine overspeed.
- High coolant temperature.
- Low lube oil pressure.

Other mechanical problems may cause the pump to shut down without starting the automatic shutdown features.

The pump operator should shut down the pump under the following conditions/situations:

- If excessive noise or vibration is noticed.
- If there is a sudden drop in discharge pressure which could be caused by a line break or operating error downstream, the speed of the pump unit will suddenly increase if the pump is operating in the automatic mode. The operator should adjust the discharge pressure set point downward by rotating the control counterclockwise to reduce the pump speed. If the problem downstream is temporary or minor, this will take care of it until it is solved. If there is a major problem downstream, the pump engine speed will continue to increase. The operator should deliberately shut down the pump unless told otherwise by the dispatcher. If the operator does not or cannot shut down the pump unit soon enough, it will shut down automatically due to engine overspeed. In the event of a sudden drop in discharge pressure when the pump is being operated in the manual mode, the operator should reduce the engine speed. If there is a major problem in the pipeline, the discharge pressure will continue to drop and the pump should be shut down unless advised otherwise by the dispatcher.
- A line break or operating error upstream can cause a sudden drop in suction pressure. Unless advised otherwise by the dispatcher, the operator should deliberately shut the pump down when the suction pressure drops to 14 PSI. If the pump is not shut down deliberately, it will start slowing down at 14 PSI and shut down if the

pressure is 10 PSI or under continuously for 15 seconds. If at all possible, manually shut the pump down before it is shut down by any of the automatic safety features. If the pump does shut down automatically, the operator should advise the dispatcher and the next upstream and downstream pump stations immediately.

If a shutdown is caused automatically by any of the situations discussed above except a sudden discharge pressure drop and engine overspeed or a sudden suction pressure drop, the operator should begin placing the spare pump on line unless the dispatcher directs otherwise. If the pump is operating in the automatic mode and the line is blocked down stream, the pump speed will be markedly reduced toward idle speed and the suction pressure will go up. Unless the operator has prior knowledge of this happening, he should immediately notify the operations downstream and the dispatcher. If the line block continues without notice that it is temporary, the pump should be shut down. If the pump is operating in the manual mode and the line is blocked downstream, discharge and suction pressures will suddenly increase. The operator should immediately reduce the pump speed to reduce the discharge pressure and should reduce to idle speed if necessary. Under no condition should the discharge pressure exceed 740 PSIG. The operator should immediately notify operations downstream and the dispatcher if this occurs. As in the automatic mode, if the line block continues without notice that it is temporary, the pump should be shut down.

Shifting Pumps During Operation

Prior to this operation, the spare pump must be flooded and purged. Open the suction gate valve. Warm the spare pump engine up with the controls in the "manual" position and the clutch disengaged. Engage the clutch with the engine at idle and open the discharge valve. Set the controls in the automatic mode and gradually move the control to match the discharge pressure of the operating pump. Monitor the suction pressure closely. The on-line operating pump will automatically slow down and the spare pump will speed up. When the discharge pressures of the two pumps match, gradually move the controls of the operating pump until the engine idles. The spare pump will speed up and take up the full load. Set the discharge pressure as necessary to hold the system flow rate desired. When the spare pump has the full load and the suction pressures are steady, the pump that was previously on line is shut down. The spare pump is now the operating pump.

Pipeline Pump Fueling Facilities

The 3,000-gallon collapsible fabric tanks are used to store fuel for operating the pump stations. There is one collapsible tank for each pump station. The tanks are located near each pump station and are operated IAW TM 5-5430-210-12. To transfer fuel from the 3,000-gallon tank to the fuel tanks on the pump skids or to an auxiliary tank, connect the hose, valve, and hand pump; then start pumping.

STRAINER ASSEMBLY OPERATIONS

A strainer assembly is installed upstream of the pipeline pumps to protect them from damage due to dirt or debris in the pipeline. The assembly contains two strainers in parallel. Normally, only one strainer is used at a time with the other one on standby. Strainers are put in service or taken out of service by opening and closing the gate valves in the assembly. Open the valves upstream and downstream of the strainer being put in service before closing the valves of the strainer being taken out of service while the pipeline is operational. Unless a strainer is being isolated for depressuring, inspection, or maintenance, leave the discharge valve open and the inlet valve closed on strainers not in service. This will avoid the possibility of overpressuring due to thermal expansion. The strainers collect dirt and debris from the line before it enters the pump. When the strainer has collected sufficient dirt, the pressure differential across the strainer will increase showing that the strainer should be removed from service and cleaned. The initial (clean) pressure drop across the strainer will vary with the rate of flow and the density/viscosity of the flowing fluid. When the pressure drop has increased to a predetermined PSI (normally not more than 5 PSI), place the other strainer in service. Block, vent, drain, and open the dirty strainer. Remove the basket and clean it. Remove any dirt that has accumulated in the bottom of the housing as well. Check the strainer for damage and wear before placing it back in the housing. Replace the strainer closure, close the drain and vent valves, and open the discharge valve. The clean strainer is then on standby and ready for service when its mate gets dirty. It is possible that something from the pipeline can cut, break, or badly erode the strainer. An

indication of this may be that the pressure drop does not increase with usage. If this is the case, disassemble and inspect the strainer as given above. If damage is found, replace or repair the strainer basket.

WARNING

Do not open the strainer closure unless the strainer is blocked in and has been thoroughly depressured by first opening the drain valve and then the vent valve. Be sure the drain hose is connected securely and routed to a collection container or sump.

PIPELINE SCRAPER OPERATIONS

Purpose

Scrapers are used to enhance and speed the initial purge and fill operations and to clean the pipeline of contaminates and obstructions that cause excessive drop in pressure. Over a period of time debris, scale, and particles that settle out of the fuel, may collect or build up in the pipeline. Line scrapers are run through the pipeline to prevent the debris from building up in the line. The pipeline dispatcher will schedule the actual scraper operation on a pumping order. Scrapers are run from the launcher at one pump station to the receiver at the next pump station. There is a scraper indicator on each barrel that shows when the scraper has been launched and received. By walking along the pipeline, the scraper can be heard as it passes each coupling.

Scraper Velocity

Scraper velocities through the 6-inch pipeline at various rates of flow are given in Table 7-2.

Table 7-2. Scraper velocity

Flow (GPM)	Velocity (MPH)
100	0.6
200	1.4
300	2.1
400	2.8
500	3.5
600	4.2
750	5.2

Types of Scrapers

Various types of scrapers or pigs for different services are available on the market. Cupped scrapers constructed entirely of polyurethane have been found to be the most serviceable in the IPDS pipeline. They are intended for general service, including purge and fill operations. Initially, five scrapers have been supplied with each launcher cleaning.

Launcher Operations

Before a scraper can be launched, the downstream receiver must be ready to trap the scraper. Insert the scraper into the pipeline using the following procedures:

- Check to make sure the launcher bypass valve is fully open.

- Close the side and mainline valves to isolate the barrel of the launcher assembly.
- Open the launcher assembly vent valve to relieve pressure from the barrel.
- Open the drain valve and drain the fuel from the launcher barrel into a container.
- Open the safety vent on the end closure and then open the launcher barrel end closure.
- Insert the scraper into the launcher barrel. Push the scraper as far as it will go into the launcher barrel.
- Close and tighten the end closure, close the safety vent valve, and close the drain valve.

NOTE: Close the safety vent valve only hand tight. If it leaks after the barrel has been filled, use a crescent wrench to tighten it.

- Set by pushing the flag down.
- Slowly open the side valve completely.
- Close the launcher assembly vent valve when the barrel is full.
- When directed by the dispatcher to launch the scraper, slowly open the mainline valve completely.
- Slowly close the bypass valve. As the bypass valve is closed, the flow is diverted through the barrel causing the scraper to be carried or forced into the pipeline.
- Watch the scraper indicater (Figure 7-11) for indication that the scraper has been launched. Notify the dispatcher the moment the scraper is launched.
- Open the bypass valve after the scraper has been carried out of the launcher barrel by the flow of fuel.
- Always operate with “wet” barrel, leaving the side, mainline, and bypass valves open.

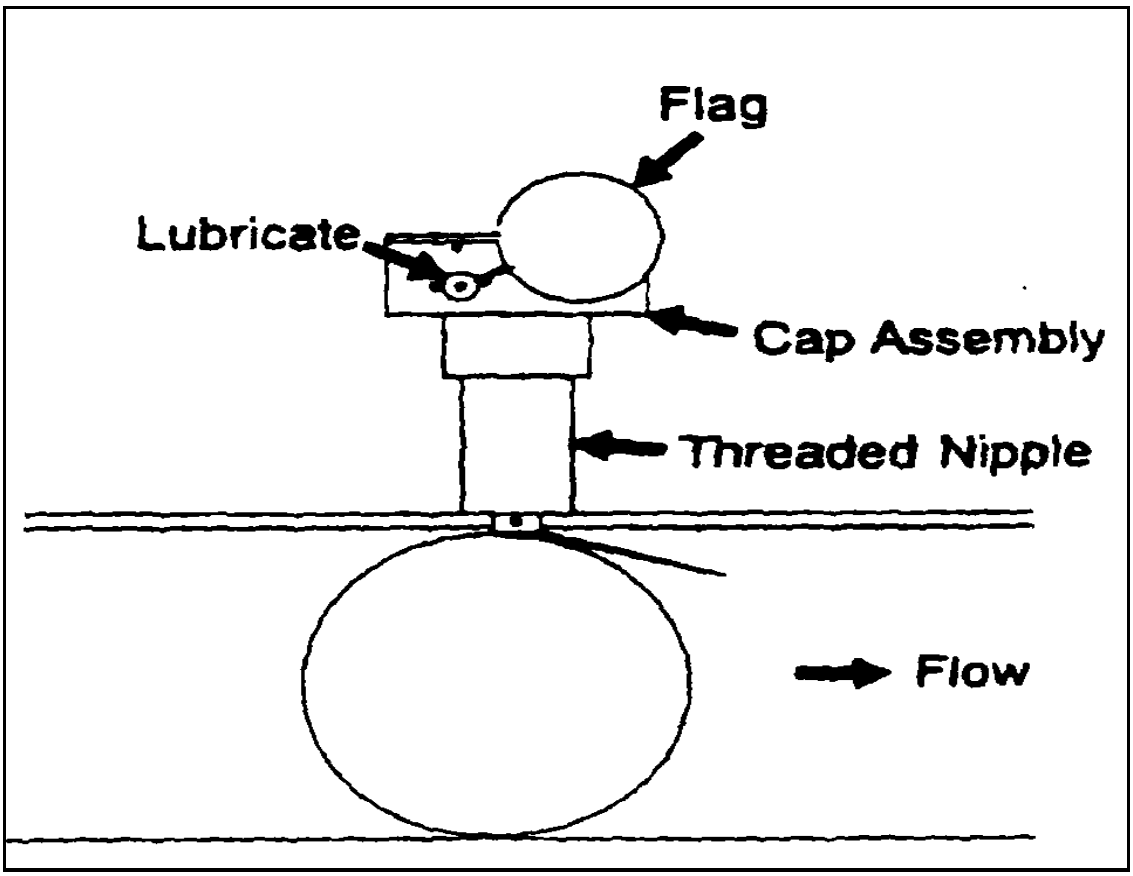

Figure 7-11. Scraper indicator

Receiver Operations

The scraper receiver assembly is shown in Figure 7-9, page 7-9**.** The recommended standard procedures to operate the receiver are discussed below. To receive the scraper:

- Make sure the receiver barrel end closure is closed and tight. Ensure the drain valve and safety vents are closed.
- Open the side, bypass, and mainline valves on the receiver assembly during normal operations.
- Set the scraper indicator.
- Close the bypass valve. This directs the flow of fuel through the barrel.

Remove the scraper from the receiver using the following procedures:

- When the scraper has entered the receiver barrel the scraper indicator will pop up.
- Notify the dispatcher of the scraper arrival.
- Open the bypass valve.
- Close the mainline and side valves.
- Open the receiver barrel vent and drain valve. Drain the product into a suitable container. Dispose of hazardous waste IAW federal, state, local, and host nation regulatory guidance.
- Open the safety vent and then open the receiver barrel end closure.

- Remove the scraper and clean out the receiver barrel.
- Close and tighten the end closure safety vent.
- Close the drain valve.
- Open the side valve slowly to fill the receiver with fuel and close the receiver barrel vent.
- After the receiver barrel is full, open the mainline valve.
- During normal operations, leave all valves open. The system should be run with a "wet" barrel.

Tracing of a Scraper

Scrapers are run from the launcher from one pump station to the receiver of the next pump station. There are several ways to trace scraper movement in the pipeline. A small battery-operated transmitter attached to the scraper sends a signal which is picked up on a receiver by a pipeline patroller. A magnetized metal scraper can be used with a detector sensitive to magnetic forces. The detector, used by a pipeline patroller, registers an increase in magnetic activity as the magnetic scraper passes by. Because the IPDS uses aluminum pipe, do not use a chain attached to the scraper. This method could cause damage to the pipe sections.

Stuck Scraper

It is possible that a scraper could get stuck in a line during a run. The scraper can probably be freed by increasing the pressure in the line. The increased force behind the scraper should push the scraper loose and move it along with the flow of fuel. Care should be taken not to overpressure the line. If increasing the pressure in the line does not free the scraper, the line must be taken apart to remove the scraper. Do not try to free a stuck scraper by putting another scraper in the line. The second scraper may not free the first one and get stuck behind it.

PURGE, FILL, AND PRESSURE TEST OPERATIONS

Purge and fill operation must remove (purge) all air from the system and fill the system with a pumpable fluid. The pressure test is to prove the integrity of the system. It does not test the strength of the system. Test pressures are therefore limited to the design maximum allowable operating pressure which is 740 PSI in the IPDS.

Internal Cleanliness Assurance

Installation procedures emphasize the importance of internal cleanliness of the pipeline. If areas of the system are suspected of containing junk, sand, construction waste, or tools, they should be disassembled and cleaned out before the purge, fill, and test is started. The initial purge and fill will clean out the remainder. The remainder will then collect in the strainers and receivers where it can be removed after the procedures are completed and before normal operations start.

Pressure Gages and Relief Valves

Before the purge, fill, and test operations can be started, all pressure gages must be reading correctly. Set the thermal relief valves to the correct relief pressure for their location.

Preparatory Steps

Before the operation can be started, all personnel involved must know their duties and the safety precautions required. Install all fire extinguishers as required. Inspect the pipelines to be filled. Make sure all couplings are properly closed and there is no excessive coupling deflection. Check that all supports, guides, anchors, and expansion/contraction devices are in place. Open all intermediate isolation gate valves installed at 1-mile intervals

in the pipeline. Close all other valves, including all vents, drains, and sampling assembly valves so there is a known starting condition. Check that adequate fuel is available at the pump stations and that the pumps and other equipment are ready for operation. Make sure the communication system is operational.

Purge, Fill, and Test Procedures

The pipeline should be initially purged, filled, and pressure-tested with fresh water from a source developed in the field. Water is injected upstream of the booster pump as close to the host nation facility or TPT as possible. The fill rate is held to about 50 GPM, until the meter and booster pump are flooded and free of air. Once the booster pump is flooded, the hydraulic power can be supplied with the system pumps. The pumps can also supply the test pressures required. A fill rate of about 200 GPM is recommended after the system is started. Scrapers are launched ahead of the water. High point vents are used as necessary to assist in removing air and vapor. Depending on the quantity of water available, the line may be tested all at once or by section. The test pressures for hoselines are not to exceed the design maximum operating pressures. Hold the test pressures long enough to thoroughly inspect the system for leaks and faults. Take the test pressure off the system and correct the leaks and faults. Retest the system after corrections have been made. To avoid corrosion, remove the water from the system immediately after the test is complete by proceeding with the fuel fill operation. In any case, a line only partially filled with water, or not fully drained and dried, must not be exposed to air for any extended period of time. The fill with fuel takes place promptly after the pressure test is complete with fuel displacing the water. The water is disposed of at the EOL. Launch scrapers at the first pump station in the line immediately after the fuel/water interface has passed to remove remaining water. The fuel/water interface is received into the head terminal contaminated fuel module and of which is subsequently disposed. Keep all water out of the clean fuel storage tank and hoseline systems. The purge and fill of the head terminal hoselines with fuel can take place after the pipeline is packed with fuel. Or it may take place with fuel from tank vehicles before the pipeline is ready. The purge and fill rate per hoseline should be kept below 200 GPM. The fill rate should be held below 50 GPM until the meters are flooded to avoid possible overspeeding due to high air flow. Purge, fill, and pressure test all hoselines in this manner before normal operations.

Alternative Purge, Fill, and Test Methods

In some cases, adequate fresh water may not be available for the recommended purge, fill, and test operations. Nevertheless, the system must be commissioned properly. Pressure testing is recommended in any case. The other methods, listed by preference based on safety, are given below:

- Diesel fuel fill preceded by a freshwater plug.
- Diesel fuel fill preceded by a nitrogen plug.
- Diesel fuel fill--scraper only.
- Jet fuel fill preceded by a water plug.
- Jet fuel fill preceded by a nitrogen plug.
- Jet fuel fill preceded by a diesel plug.

The reference to a plug above means a quantity of a buffer fluid, liquid, or gas, ahead of the fill fluid. The procedure is to launch a cupped scraper at the head of the buffer fluid and another ahead of the fill fluid. This creates a plug or buffer zone between the volatile fill fluid and the air in the pipeline. A large quantity of plug is not required. A plug of 1,000 gallons of water, which is about 650 feet long, is adequate. A 300-cubic foot cylinder of nitrogen would provide a plug over 1,000 feet long. The "plug" fluid volume must be maintained. It may be necessary to inject more volume due to losses. Due to the difficulty of ensuring that a nitrogen plug has not been lost or overly diluted, a new plug volume must be injected at the launcher before each fill and test of a pipeline section. If there is any doubt as to the nitrogen plug volume or purity, inject more nitrogen. The order of the listing of the purge and fill methods above is related to the volatility and flash point of the fill and test fluid. Avoid explosive fuel/air mixtures in the pipeline. Use less volatile and flammable fluids for testing or initial use in the pipeline. An initial diesel fuel fill is preferred if available. Jet fuels with relatively high flash points such as JP-5, JP-8, Jet A-1, or other commercial jet fuel grades of known high flash point are acceptable with the plugs listed.

Jet fuel, JP-4, should be avoided as the initial fill and test fluid due to its low flash point. If it must be used, take special care to maintain low flow rates and an adequate buffer plug. MOGAS is not recommended as the initial purge and fill fluid.

PIPELINE FUEL TRANSFER

The IPDS is designed to operate without direct communications; however, normal operations should be conducted with communications between the dispatcher, the pump stations, and the head terminals. For safety reasons, the receiving terminal controls fuel transfers. Confirm that the terminal is ready and can receive fuel before pumping starts. The terminal must be able to stop the flow of fuel. This includes shutdown due to the completion of a planned fuel transfer or for other reasons. Normally, operate the pipeline pumps in the automatic discharge pressure control mode with the operator setting the control point. Monitor the discharge pressure continuously for high pressures in excess of the control set point. Shut the pump down if the discharge pressure exceeds 740 PSI.

Transfer Procedures

Fuel is transferred from the host nation bulk facility or beach termination unit to the head terminal. Pumping must start with the supplying bulk facility. Start the booster pump as soon there is enough suction pressure (5 to 10 PSI minimum). Start pumping at the pump stations when suction pressures reach 70 to 100 PSI. Keep suction pressures in this range until relatively steady conditions are established. Then keep them above 50 PSI. Increase pumping rates to 600 GPM or higher, starting with the supplying bulk facility pumps (if available) and then at the booster pump and the pipeline pump stations. Suction pressure available is the controlling factor. Control pressure below 125 PSI into the head terminal by the pressure regulating valve assembly at the EOL or TPT intake. Control back pressure in the pipeline at a minimum of 50 PSI.

Shut-Down Procedures

The pipeline is normally shut down by first shutting down the pump station closest to the head terminal. The pressure regulating valve at the EOL or TPT intake will automatically close when the upstream pressure drops to 50 PSI. If the line is blocked in downstream of the EOL or TPT intake pressure regulator, the last closest pump station is shut down when the suction pressure begins to increase. The booster pump is shut down when the suction pressure begins to increase or as the first pump station is shut down. The supplying bulk facility pumps are shut down when the booster pump shuts down. Under these conditions, the line is blocked in fully packed and under pressure.

Communication Failure

If communications fail and the terminal must stop the flow of fuel, do so by blocking in downstream of the EOL pressure regulating valve, which will cause it to close. The pump in the next upstream pump station will go into idle or greatly reduce in speed due to the restricted flow and the automatic discharge pressure control. The suction pressure will increase rapidly. These indicators will signal the operator to shut the pumps down. Each pump station downstream in succession will shut down when the operator sees the suction pressure increase or the pump goes into idle or greatly reduces in speed. The booster pumps will shut down when the first pump station in the line shuts down.

EMERGENCY OPERATING PROCEDURES

Emergency operating procedures are given in Table 7-3, pages 7-25, and 7-26. Use these procedures when an emergency arises.

Table 7-3. Emergency operating procedures

Emergency Condition	Procedure
Pipeline Separation	Immediately shut down pumping. The pump immediately upstream of the break will possibly shut down on overspeed. Immediately isolate the first upstream and first downstream pump station from the break by closing the appropriate block valves. As soon as possible, close the intermediate isolation gate valves on both sides of the break that are safely accessible. Route fire-fighting equipment and crews to the area of the break. If possible to do so safely, isolate the spill with earth diking and ditching. Drain the spill away from the pipeline, if possible. If fire occurs, extinguish the fire and stand by. Clean up the spill. Start repairs and recommissioning. Determine the cause of the break and take corrective action to avoid recurrence.
Serious Pipeline Leak	Shut down pumping in an orderly fashion. Shut down upstream first and downstream when the suction pressure drops to 15 PSI, thus reducing the line pressure as much as possible. Close the intermediate isolation gate valves closest to and either side of the leak. Route fire-fighting equipment and personnel to the leak location. If a fire occurs, extinguish the fire and stand by. If there is a liquid accumulation, clean it up or drain it away from the pipeline when it is possible to do so safely. Depressure and drain the line in the area of the leak as necessary to repair the leak. Start repairs and recommissioning. Determine the cause of the leak and take corrective action to avoid recurrence.
Hoseline Break or Serious Leak	Shut down any transfer taking place in that hoseline. Route fire-fighting equipment and personnel to the leak area. Extinguish any fire and stand by. Block in the hoseline in the section having the leak. Depressure if under pressure. Drain the hoseline in that segment. Move the hoseline away from the spill area, and if possible, repair or replace it. Isolate the spill and clean it up.
Fabric Tank Rupture or Serious Leak	Shut down any pumping into that tank. Start pumping out of the tank to another tank that is a safe distance from the ruptured tank. Empty the ruptured tank. Route fire-fighting equipment and personnel to the tank location. Extinguish any fire and stand by. Check the integrity of the berm. Correct to the extent it is safe to do so. If the berm has broken out or is leaking seriously, isolate the drainage with earthen dikes. Pump out any accumulated fuel inside the berm.

	Repair or replace the tank.

Table 7-3. Emergency operating procedures (continued)

Emergency Condition	Procedure
Break or Serious Leak in Pump Station	Shut down the pump station. Close the block valves on each side of break. Bring in fire-fighting equipment and personnel. If there is a fire, extinguish it and stand by. Clean up the spill. Determine the cause of the break, make corrections, and repair or replace necessary equipment.
Serious Spill Due to Operator Error	Immediately shut down the pump or pumps supplying the spill. Shut off valves nearest the spill that can be closed safely. Move fire-fighting equipment and personnel to the area of the spill. Extinguish any fire and stand by. Clean up the spill. Educate the persons whose error caused the spill and begin operations.
Overflowing Tank	Shut down pumping into that tank. Start pumping out of the overflowing tank bringing the level down to an acceptable point. Route fire-fighting equipment and personnel to the tank area. If a fire results, put it out and stand by. Pump out any accumulated fuel inside the berm. Inspect the tank for damage. Start operations with that tank as necessary.
Fire	Immediately shut off flow of fuel to the area. If in a pump station or terminal, shut down all operations. Route fire-fighting equipment and personnel to the area and start extinguishing the fire. When the fire is under control, stand by. Evacuate personnel not involved in the fire or critical to operations. Remove any fuel accumulations that caused the fire or are subject to reignition. Determine the cause of the fire and correct it. Make repairs or replacements as necessary.

Section IV. Maintenance

LUBRICATION PRACTICES

Mechanical equipment requires lubrication to overcome friction and minimize wear, damage, or corrosion. Lubricate equipment IAW U.S. Army lubrication orders, when available, and other established procedures. The major equipment items requiring lubrication are the pumps and engines. Valves and other equipment require lubrication to keep them operating smoothly. Pivot points on various equipment should be lubricated regularly. Lubricate closure surfaces to prevent corrosion. Coat unpainted surfaces with lubricant or preservative oil to prevent corrosion. Lubrication work can generally be handled along with the preventive maintenance program.

VALVE MAINTENANCE

Valves are devices used in pipelines and terminals to control the flow of fuel. For the most part, they are hand operated. They can start, stop, direct, and slow the fuel stream. There are several kinds of valves; each is designed to do a specific job. This section covers thermal pressure relief valves, pressure regulating valves, gate valves, check valves, ball valves, and needle valves. Each of these valves has special maintenance requirements. To maintain the valves in the best possible condition, follow these precautions:

- Never force a valve with a wrench. Try to find out why it is stuck; maybe the packing is too tight.
- Open and close valves slowly to prevent damage.
- Make sure pump station operators know which valves are being opened or closed.
- Try to avoid interrupting pumping operations with maintenance operations.
- Periodically inspect the outside of the valves for dirt; clean as necessary.
- Inspect the outside of the valve for rust. If the outside is corroded, scrape the valve to bare metal, coat with primer, and paint with approved paint. Do not paint the valve stems.

Valve Removal

Valves on the IPDS are fitted with flanges on each side. These flanges bolt onto flanged fittings, which, in turn, are coupled or welded to the pipeline. If a valve becomes worn or damaged, it should be replaced. To remove a valve from a pipeline or terminal follow these steps:

- Block off the line on each side of the defective valve and stage fire-fighting equipment.
- Place a container under the valve to catch any spilled fuel. Dispose of the drained fuel IAW the local SOP for hazardous materials.
- Remove the flange bolts and gaskets.
- Remove the defective valve.
- Clean the flanges on the new valve with a wire brush. Do not damage the surface of the flange.
- Wipe off dirt with dry-cleaning solvent.
- Coat the new gaskets with grease.
- Lubricate the flange bolts with a thin film of grease.
- Place the gaskets on the flanges and align the valve flanges with the pipe flanges.
- Replace the flange bolts. Work around the flanges, tightening first one bolt and then the bolt exactly opposite it on the other side of the face of the flange until all the bolts have been tightened evenly.

- Open the line to fuel flow and check for leaks.

Gate Valve Maintenance

Gate valves are used in pipelines to start or stop the flow of fuel. Gate valves get their names from gates made up of two disks that are separated by a solid or split wedge. When the disks are lowered into the fuel stream, the wedge forces the disks apart and pushes them against their seats to create a seal. This cuts off fuel flow completely. Raising the wedge and disks allows fuel to flow freely and allows scrapers to pass through the valve. Gate valves may have rising stems or nonrising stems. Both types lower a gate slowly into the fuel stream, reducing the amount of surge pressure produced in the line. When a gate valve has a rising stem, the handwheel remains at the same height as it is turned. Turning the wheel counterclockwise causes a threaded stem in the center to rise, bringing the gate up with it. Turning the wheel clockwise causes the stem to move down, lowering the gate into place. One advantage of the rising stem gate valve is that it is easy to tell at a glance whether or not the gate is open or closed. The stem sticks out above the wheel when the valve is open, and it is level with the wheel when the valve is closed. When a valve has a nonrising stem, the stem does not move up or down. As the handwheel is turned, the gate moves up or down on an internal threaded stem. Operate a gate valve in the completely open or completely shut position. Do not use it to slow or throttle fuel by half closing the gate. This will cause too much wear on the disks, and they will no longer form a tight seal in the closed position. Operators should back off on the handwheel a quarter of a turn to prevent freezing. These precautions will prolong the life of a gate valve. Tighten the packing nuts with even tension if the valve is leaking around the stem. Repack the valve if tightening the packing nuts does not stop the leak. To repack the valve:

- Close the valve completely to keep fuel in the line.
- Remove the handwheel nut and handwheel on nonrising stem gate valves. Skip this step on rising stem gate valves.
- Remove the packing nuts, packing flange, and gland.
- Remove the old packing from the stuffing box with a packing tool. Clean the stuffing box.
- Cut a new piece of graphite spiral or graphite rings to fit the stuffing box. Use the old packing as a cutting guide. If rings are used, cut the rings so that the ends meet exactly.
- Coil the new piece of graphite into the stuffing box or place rings on top of one another in such a way that the ends of each layer meet on the opposite side of the stem from the previous layer. Force packing down firmly in place.
- Put the gland, packing flange, and packing nuts back in place. Alternate tightening the nuts. Back off on nuts until they are a little more than hand tight.
- Put the handwheel and handwheel nuts back in place. Tighten the nut.
- Open the valve and check for leaks. If necessary, adjust packing nuts to stop a leak.

Check Valve Maintenance

Check valves are used on the discharge side of pumps and in tank farm manifolds to prevent the backflow of fuel. A hinged disk allows fuel to flow in one direction only. Fuel flowing in the right direction pushes the hinged disk out of the way. Fuel flowing in the wrong direction pushes the disk against its seat and closes the opening. An arrow on top of the valve points to the correct fuel flow direction. Check valves are self-operating and require little maintenance other than tightening the cover nuts regularly. Brush scrapers cannot pass through check valves.

Ball Valve Maintenance

There are several sizes of ball valves used in the IPDS. They range from one-half-inch to 4 inches. They are used on various vents and drains and under pressure gages and thermal relief valves. The 4-inch ball valve is used

as the side valve on receivers and launchers. The only maintenance required of the ball valves is to periodically ensure that they are operating properly.

Thermal Relief Valve Maintenance

Thermal relief valves are installed on the receivers and launchers in all areas of the pipeline. There is no operator maintenance required of these valves. Periodically ensure that they are operating properly.

STRAINER ASSEMBLY MAINTENANCE

Strainer assemblies should be inspected often and cleaned on an as-needed basis. How often they will need cleaning depends on how much fuel is pumped through the line strainers and how much debris is carried into the strainers by the fuel. Actually going into the strainers and checking the baskets may be the only way to tell if they need cleaning. On some lines, pressure gages may have been installed on each side of a strainer assembly. The difference between the readings on these two gages is called the pressure differential. The pressure differential should be noted and recorded on a regular basis. If the pressure differential increases over a period of time; that is, if the difference between the two readings increases, pressure is dropping from one side of the strainer to the other. This is probably because a layer of particles is blocking the flow and the strainer needs cleaning. To clean a strainer assembly follow these steps:

- Make sure an extra strainer basket and gasket are on hand.
- Stop pumping operations.
- Close the gate valves on each side of the strainer.
- Place a container nearby to catch any spilled fuel and to hold the strainer basket removed from the assembly.
- Remove the nuts from the bolts that hold the strainer cover in place.
- Remove the cover.
- Carefully lift out the basket. Do not hit the basket against the housing. This could damage the basket and cause debris to drop down into the housing.
- Put the dirty basket in the container.
- Replace the cover on the line strainer, but do not bolt it down.
- Clean the basket that was removed from the assembly by using compressed air or high pressure water. Direct the flow of air or water against the outside of the basket in the opposite direction to the flow of fuel. This will force dirt out of the screen and basket. Remove any gum or tar with dry-cleaning solvent. Use a soft brush to apply the solvent to the outside of the basket.
- Inspect the basket for rust. If the basket has become rusty, replace it with the extra basket.
- Inspect the gasket. If it is worn, replace it with a new one.
- Put the cover back in place.
- Replace the nuts and tighten them.
- Open the gate valves on each side of the strainer assembly.
- Start pumping operations.
- Check for leaks around the strainer.

PUMP UNIT MAINTENANCE

All maintenance must comply with special permit conditions which may exist. Consult the local Environmental Compliance Officer to ensure proper operations at all times. Pump operators and mechanics must read the applicable manufacturer's technical manuals and current lubrication orders for their pump units. These publications give directions for operating specific pump units and instructions on maintaining them. Pump units that are used frequently should be inspected daily by the operator. Idle pump units should be inspected regularly to make sure they can be put into use quickly. Defects should be noted and repaired before they damage the pump units. Defects that develop during pumping operations should be repaired as soon as pumping operations come to an end. If a problem develops which could damage the pump units or other pieces of equipment, pumping operations should be stopped at once. Some maintenance should be performed daily on pump units before, during, or after pumping operations. Other actions should be done quarterly or after 250 hours of operation, whichever comes first.

PRESSURE GAGE MAINTENANCE

Pressure gages are instruments used in pipelines and storage facilities to measure and show the amount of force being exerted by the fuel. A pressure gage is made up of a glass front, a pressure indicator or dial, a numbered scale, and a lever system. This lever system measures the pressure and moves the indicator to a particular reading on the scale. Gages can be damaged by rust, vibrations, excess pressure, physical abuse, and stress to the metal. Inspect gages often. Replace broken glass and tighten loose covers. If the outside of a gage is slightly rusty, carefully sand it down to the bare metal then prime and repaint it. If a gage is extremely rusty or cannot be repaired on the spot, report the gage to the pump station operator or pipeline supervisor. Also, report a gage that appears to be registering incorrect readings so that it can be calibrated.

METER MAINTENANCE

Meters are devices used to keep track of the amount of fuel that flows through sections of pipeline and into or out of storage tanks or tank cars. They can cut down on losses during fuel receipts and deliveries. Meters can also be used to detect leaks because a drop in throughput from one meter to the next is a sign that fuel is being lost between those meters. Positive displacement meters are most frequently used. These meters allow only a set number of gallons of fuel to enter a measuring chamber. Then an inside mechanism rotates and the fuel is emptied out of the chamber. The meter then registers that amount of fuel in gallons on a counter. Organizational maintenance on meters is limited to simple repairs. Do not try to take a meter completely apart in the field. The following steps can be taken at organizational level:

- Pack the Driveshaft. Read the manufacturer's manual for the meter. Note that the driveshaft is packed with ring packing to prevent leaks. If the meter is leaking, tighten the packing gland by hand. If this does not stop the leak, the ring packing probably needs replacing. Follow the directions in the manufacturer's manual to put in new ring packing.

- Replace Gaskets. Follow the directions in the manufacturer's manual to replace worn gaskets. Make sure the gaskets are the right kind for that meter. Using a gasket that is the wrong size or thickness will cause vibrations in the meter.

- Lubricate. Add a few drops of light, general-purpose lubricating oil to the oiler. Do this often to make sure all the parts of the meter are moving freely. Also, oil the countershaft, countergears, totalizer shutter, shutter keyhole, and all working points with jewel bearing instrument lubricating oil. Check the diagram in the manufacturer's manual to locate these points.

- Remove Water and Sediment. Remove the meter drain plug once a week to let the water and sediment flow out of the bottom of the meter. Replace the plug when the bottom is clean. If the meter has not been used in sometime, drain out the water and sediment before putting the meter back on the line.

PIPELINE MAINTENANCE

Over a period of time, debris collects or builds up in a pipeline. This debris may be small fragments, slag, pieces of gaskets, and filings left over from the construction and repair of the pipeline. It may also be particles that settle out of the fuel during daily operations. When debris starts to collect in the pipeline, the pipeline becomes

rough. Friction builds up in the line, slowing the flow of fuel. As the fuel stream slows down, more debris settles out and the diameter of the pipeline becomes smaller. Less fuel passes through the line and the capability of the pumps to push fuel through the line is reduced. If the buildup of debris is allowed to continue, strainers clog, fuel is contaminated, and eventually the pipe is completely blocked. See Section III of this chapter on pipeline scraper operations.